Motorola
newsgram
Bi-Monthly Publication of Motorola Inc.
Communications and Electronics Division

May-June, 1954

In this issue . . .

Freeport Sulphur Company's Microwave System Spans Marshlands of Southern Louisiana

SPECTRUM EXPANDERS

D. E. Noble

So far, no one has come up with a successful spectrum expander. The expansion of the mobile radio installations has been phenomenal. There are probably more than 350,000 mobile transmitters in use today, and the number is still growing. To keep the interference under control and to accommodate the flood of mobile radio systems, we first resorted to adjacent channel operation; and now we are headed toward channel splitting for additional spectrum conservation. After splitting channels, where do we go from there?

To my mind, there are three basic areas of expansion still open to us:

(1) Through a change from the FCC policy of allocating channels to each service on a national basis, to the allocation of channels to each service based upon the needs of each local area.

(2) If, as many observers believe, FM broadcasting becomes economically unsound and the channels fall into disuse, additional channels will be available through the logical reassignment to the mobile services.

(3) Over a rather extended period of years, as the development of suitable tubes and equipment in the microwave field takes place, new channels will be found through the use of microwave mobile communications equipment. I look to the 940 to 960 Mc. range as the next important mobile radio expansion area.

A solution of the problem of r.f. selectivity will eliminate the serious intermodulation and desensitizing problems, and so will make the use of split channels entirely practical. Station clustering is a poor solution to many of our problems, and for the present, the coordinated, geographical separation of main stations is the best compromise.

Many areas of our country would have adequate spectrum space for a long time to come, if we could get away from the wasteful practice of assigning channels on a national pattern, with the wanton disregard for the needs of the particular local area. The national pattern has been followed by the FCC only because of the staff limitation which forbids any attempt to administer a much more complex local area assignment plan. The channels have been wasted, and they will continue to be wasted, simply because the Federal Communications Commission does not have the money and the manpower to administer the assignments. So long as there have been channels enough to go around, there was no need to be disturbed about this waste of spectrum space, but as the channel occupancy becomes greater and greater, such waste becomes categorically intolerable, and something must be done about it.

It would not seem to me that the proper solution would be the erection of an involved bureaucratic structure under the FCC, to administer the more complex plan. There should be a more practicable and simple method for achieving the results without resorting to unwieldy, high-tax control methods. The answer would seem to lie in the development of a licensee association which will achieve a large degree of self-coordination and self-discipline in cooperation with the FCC. Many of you will remember that, at the time the RTPB Panel 13 was dissolved, I proposed that a licensee organization should be formed, establishing a national policy-making group for all mobile communications systems licensees. It was my suggestion that this organization would be made up of equipment users or licensees only, and manufacturers would have no voting representation in the association. It is my present opinion that this association should be sponsored directly by the Federal Communications Commission under the designation "Radio Technical Commission for Land-Mobile Services." The executive committee would consist of elected representatives from each of the identified service groups.

In each allocation region or particular area, there would be local chapters, or committees of licensees for each service, and the chairman of each committee would join with all the other chairmen to form an inter-service committee. Thus, we would develop a pattern for negotiation and for self-government within the rules and regulations laid down by the FCC.

It will take years to develop the effective organization necessary for the proper handling of the responsibilities, but the result would be worthwhile, and the method is in tune with our fundamental principles of democratic action. The first step in the process is the formation of the RTCL by the Federal Communications Commission. The Commission has demonstrated the importance and practibility of the RTCM and RTCA, so we should find the Commissioners eager to foster the development of RTCL for the land-mobile services as a key to the administration of area allocations. I do not propose to start this organization, because there is always someone sure to question the motives of a manufacturer in an action of this kind. I am merely pointing out the deep-rooted need for such an organization, and I am hoping that the Federal Communications Commission will arise to its full responsibility in this matter by initiating a constructive plan of action. This is the road to tax saving and channel saving, and we need both. And, if any of the mobile services ask the question, "What's in it for us?", I'll answer that with a question. "What's in it for the United States of America?". We both know the correct answer.

Dan Noble

The

Motorola Newsgram

Copyright, 1954 by

Motorola, Inc.

Communications and Electronics Division

Technical Information Center

FEATURES

Microwave Relay Conquers the Muddy Marshlands 4–5
Pickup and Delivery Costs Can Be Pared 6–7
Pushbutton Police Protection 8–9
Progressive Plumber Triples Service Business 10–11
Two-Way Builds for the Future 12–13
Portables vs. Poachers.... 14
Radio Benefits Small Rural Telephone Co..... 15

PHOTO GALLERY

Formula for Picture Headlines 16–17
Radio—Dog's Best Friend. 18–19

TECH NOTES

Integrated Systems..... 20–21
Service Hints and Shop Notes 22–23
New 6/12-V. Mobile Radio 24–25
Supervisory Control..... 26–27
Intermodulation 28–29

NEWS

Late News 3
Transmissions and Regional Directory 30
Inside Motorola 31

COVER PHOTO

Freeport Sulphur Company's microwave terminal atop American Bank Building in New Orleans.

Please address all inquiries concerning sales, service or distribution to:

MOTOROLA COMMUNICATIONS and ELECTRONICS, INC.
4501 W. Augusta Blvd.
Chicago 51, Illinois

BRICKLEY APPOINTED NORTHWEST REGIONAL MANAGER

Donald F. Brickley has been named manager of the company's Region 1 covering the states of Idaho, Montana, eastern Nevada, Washington, Wyoming and Utah.

Before taking over direction of the Pacific Northwest sales activities of Motorola Communications & Electronics, Inc., Brickley was for four years the company's zone manager in northern Illinois.

Donald F. Brickley

He joined the parent company, Motorola Inc., in 1937 as a production employee and later moved into the purchasing department. He was appointed a radio communications engineer in 1948 and was made zone manager in 1950.

Brickley is an Air Force veteran of World War II, entering service in 1942 as a private and attaining the rank of captain before he returned to Motorola in 1945. His military service was with the 5th Air Force in the Philippines, Okinawa and Japan.

With appointment of Brickley as regional manager, the regional headquarters formerly located in San Mateo, California will be moved to Portland, Oregon. The West Coast parts and service depot will continue to function from San Mateo. Northern California, which was previously in Region 1, will now be served by the Motorola region with headquarters in Los Angeles. This alignment of regional activities will insure improved service to users of Motorola communications equipment in the fast growing Northwest area.

Parts & Service Depts. Move to New Quarters

After August 1st the Parts and Service Departments of Motorola Communications and Electronics, Inc. will be re-located in new, more spacious quarters. The new address will be 1414 North Cicero Avenue, Chicago 51, Illinois.

The new streamlined facilities will include 20,000 square feet of shop and office space. With the increased efficiency expected, the goal of the departments will be to provide same day service.

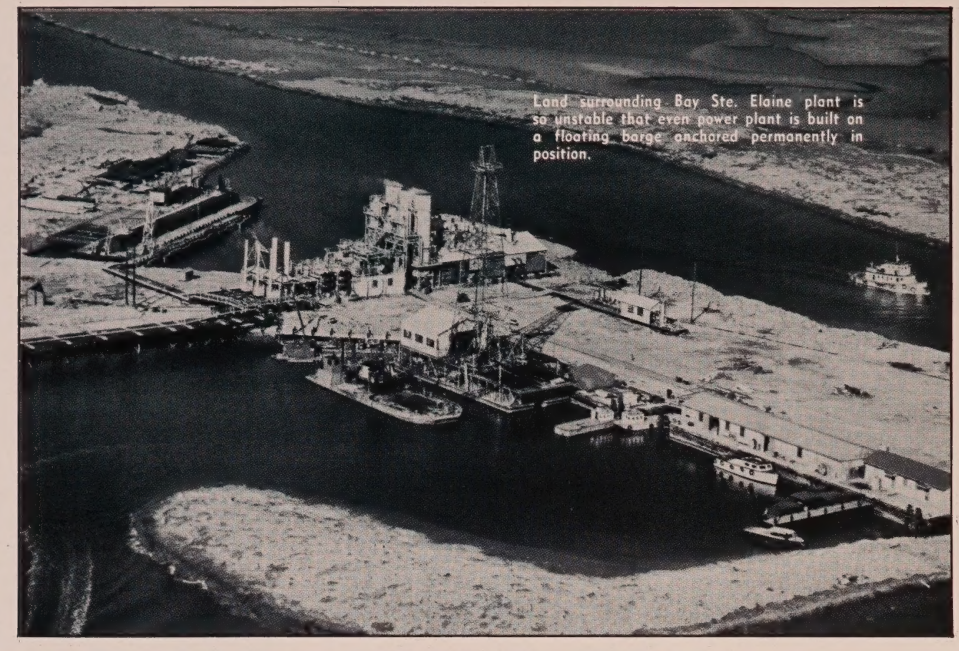
Truck Dispatcher Aids Available

Motor carriers interested in two-way radio are being offered two new aids to efficient operation.

One is a truck dispatcher's handbook showing how to integrate radio into the conventional method for controlling truck movements including tips for teaching drivers the use of radio equipment.

Also offered is a dispatcher's sample worksheet with explanations of how two-way radio can increase driver productivity as much as 20 percent.

Both training aids have been developed by Motorola in conjunction with motor carriers across the nation. Copies may be obtained without obligation by writing to the editor.



Land surrounding Bay Ste. Elaine plant is so unstable that even power plant is built on a floating barge anchored permanently in position.

MICROWAVE RELAY CONQUERS THE MUDDY MARSHLANDS

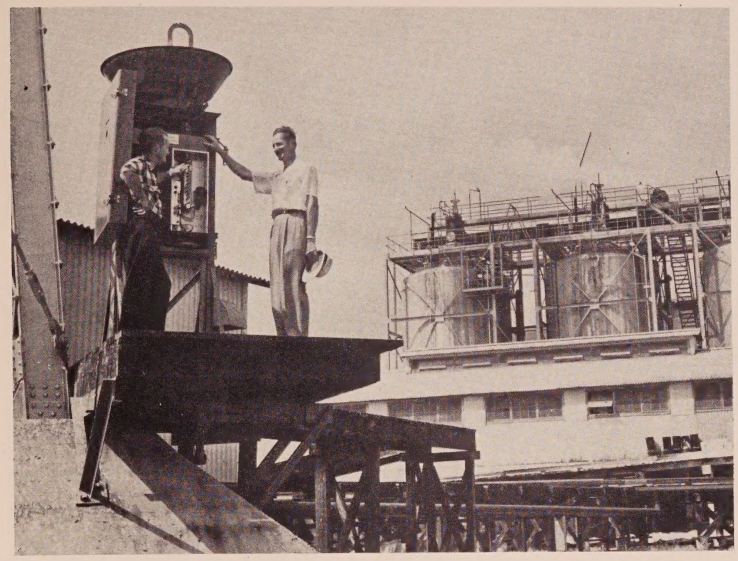
In Louisiana's Gulf Coast region, a Motorola microwave system provides otherwise impossible communications for the widespread sulphur mining operations of the Freeport Sulphur Company, second largest sulphur producer in the U. S.

Alligator infested swampland, so spongy that 75-foot long foundation pilings sink 45 feet without being struck, isn't especially suited to telephone line construction. At least that was the verdict of management and communications specialists of the Freeport Sulphur Company when they laid plans for a new communications facility tying together their mines and offices in the mucky marshlands of southern Louisiana. The Federal Communications Commission was quick to agree and subsequently authorized construction of the first microwave system in the Special Industrial Service.

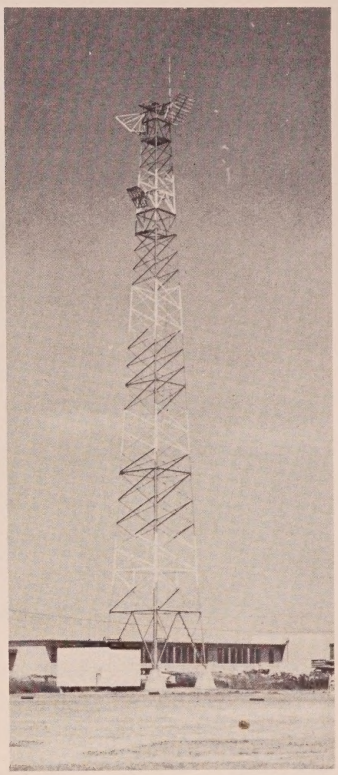
Stretching southward over 40 miles from New Orleans, where the company's main operating offices are located, the system extends to the shipping center and field operations office at Port Arthur. It then branches off to the west to mines at Grand Ecaille and Bay Ste. Elaine and to the east to the Garden Island Bay mine in the Mississippi delta.

Because the mines and plant sites are virtually isolated and in most cases can be reached only by boat or seaplane, reliable communications are absolutely essential. Not only does a microwave system provide this high degree of reliability, but it also permits easy system expansion and flexibility as communications traffic grows. The eight station system which has now been in and operating for over a year, has an ultimate capacity of twelve duplex or two-way channels. All circuits are currently being used for voice communications.

In addition to the many voice conversations that may be carried on simultaneously over the system, a tie-in feature with existing ship-to-shore radiotelephone facilities permits VHF radio contact from New Orleans or any of the mines to the fleet of towboats, barges, workboats and other marine units which the company operates on the Mississippi.

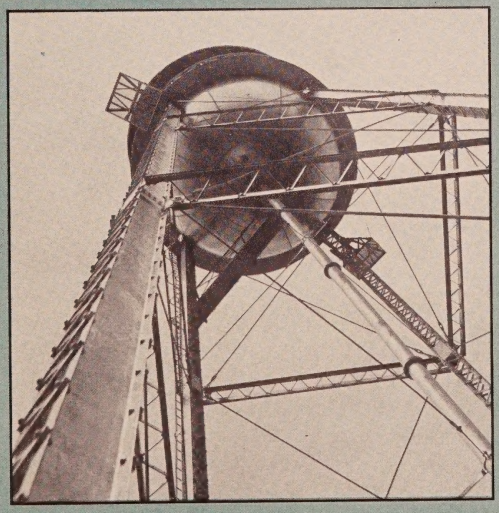


A. J. "Gus" Lehman (right), division superintendent of electrical engineering of the Freeport Sulphur Company, and Harry C. Hill, Motorola industrial communications engineer, inspect microwave installation at Grand Ecaille.

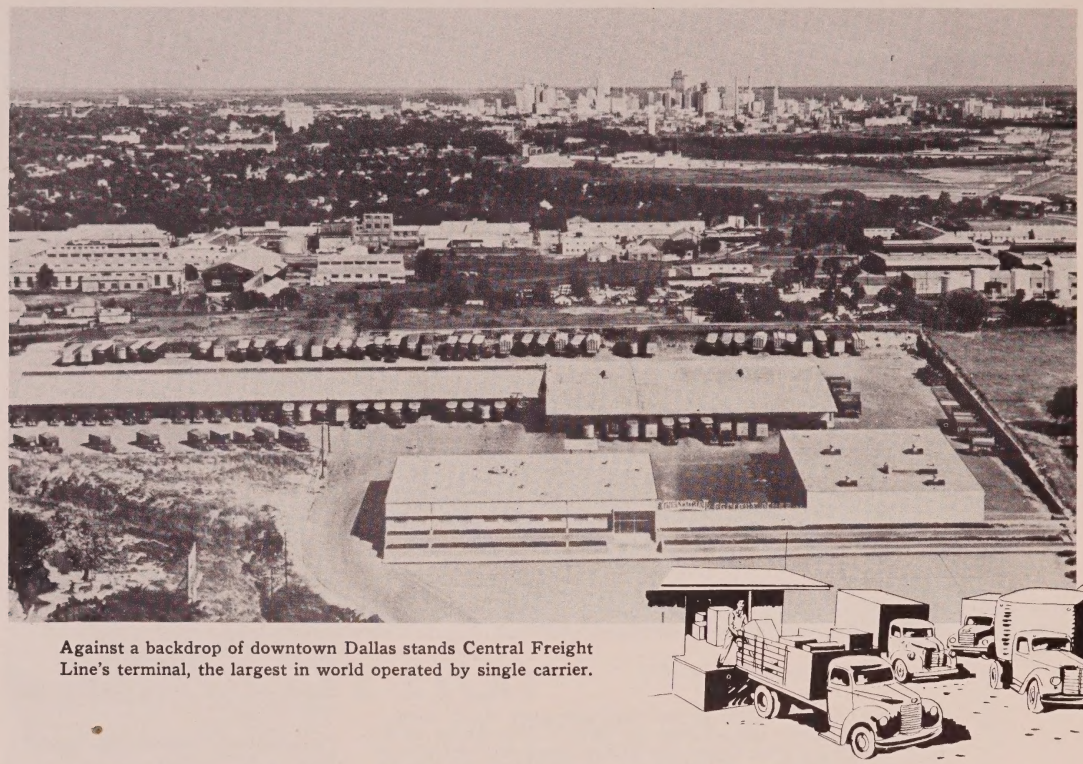


Microwave tower at Port Arthur field operations office. Sulphur in the liquid state is shipped from the mines to Port Arthur where it is stockpiled for shipment around the world. Coordination of field operations from this center demands constant, uncongested communication facilities.

Microwave reflectors at Grand Ecaille and Garden Island Bay mines are installed at the top of existing water towers. "Remote" type RF equipment is installed at the tower base.



"Micropackage" microwave installation at Port Sulphur includes three directional antenna system. Rooftop parabolic antennas are each aimed at separate tower mounted reflectors.



Against a backdrop of downtown Dallas stands Central Freight Line's terminal, the largest in world operated by single carrier.

PICKUP AND DELIVERY COSTS CAN BE PARED

Texas Truck Line Uses Two-Way Radio To Make 5 Trucks Do The Work of 6.

Harold Callan, Dallas manager for fast-growing Central Freight Lines.

An up-and-coming Texas motor freight line has found a way to make five trucks do the work of six.

Central Freight Lines Inc. chose Dallas as a test city to determine whether two-way radio could increase efficiency of trucks in less-than-truckload service.

After six months in operation, productivity of radio equipped vehicles was up at least 20 per cent, reports Harold Callan, vice president and Dallas manager for the Texas-wide carrier.

Central went on the air in July, 1953, with a base station and 15 truck radios, operating in the 460 mc. Citizens Band. The difference in productivity became apparent almost at once. A survey showed that the radio trucks were each averaging two pickup stops a day more than the isolated vehicles.

Radio drivers save as much as an hour a day apiece by not having to hunt parking places and leave their trucks just to find a public phone.

Before installing the Motorola radio system, Central's Chief Dispatcher Earl H. Vincell depended entirely on telephones to keep track of his 60-odd trucks. The telephone load lightened immediately, Vincell found, because he can give out three calls by radio in the time it takes for one over the telephone.

More important, two-way radio has given Vincell direct control over his trucks—quite a change

from the old system in which he was powerless to reach a driver unless the driver telephoned in. The gaps in the dispatcher's control just don't exist, now that he in effect is sitting right in the cab with the driver.

The transition from old-style to modern dispatching has been very smooth. Incoming phone calls reach Vincell and Relief Dispatcher Marvin Tabor through their headsets. Incoming radio calls emanate from a loudspeaker in the dispatch office. To keep their hands free for writing, the dispatchers use a foot-operated switch to turn the radio transmitter on and off.

As more trucks are added to Central's Dallas fleet, there will be a gradual shift in emphasis from telephone to microphone.

The radio is most valuable between 1 and 4:30 p. m., when 75 per cent of Central's unscheduled pickup orders come in. A truck may be within a few blocks of the shipper's dock when the call comes. By radio the dispatcher can divert the driver immediately, saving time and the miles of doubling back along his route.

During late afternoon hours, the radio drivers are given one pickup order at a time. This assures the dispatcher tight control —much better than he has over the "phone-in" drivers who usually are given two or more stops per phone call.

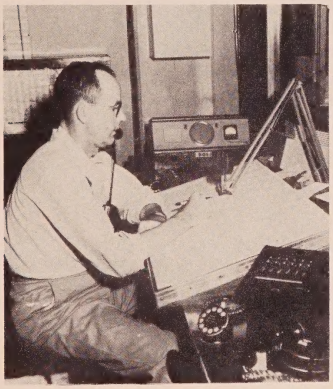
The Motorola FM base station is housed in a compact cabinet within reach of the dispatcher. The radio signal radiates from a non-directional antenna atop a 138-foot tower beside the dispatching office. Tests have shown that the signal blankets a 25-mile circle around the terminal—easily covering the normal dispatch area.

Callan foresees a much wider use of two-way radio by his company, now that the Dallas test has proven the value of instantaneous communication. The company plans to double the number of radio-equipped trucks in Dallas and already has ordered a Motorola system for the next expansion—a new Central Freight Lines terminal to serve the Sabine-Neches area of the Texas Gulf Coast.

Besides having a radio truck on every city route, Callan eventually wants Motorola radios in the Claims Prevention Department's cars, and in supervisors' autos.

With the radios giving each Central driver an extra hour of productive time every day, it's no wonder that Callan says:

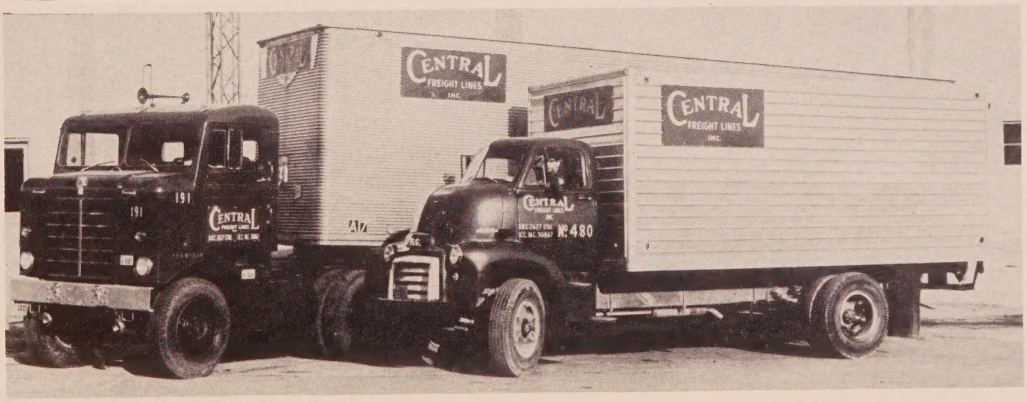
"I'm completely sold on two-way radio!"



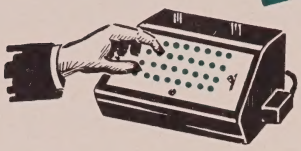
Left: Dispatcher Marvin Tabor gives orders to Central's radio-equipped trucks anywhere within a 25-mile radius of the line's new Dallas terminal.

Right: Driver Harvey Cook reports in by radio after completing each stop. Two-way radio saves drivers up to an hour per day, survey shows.

Below: Central uses 2½-ton cab-over-engine trucks in city, square-nose diesels on road.



PUSHBUTTON POLICE PROTECTION



Quik-Call turns on light, recalls men to squad car when trouble breaks out in crime-hating Cleveland.

Cleveland's police radio dispatcher checked his watch at 1:04 a.m., stretched and yawned. It was a slow moving night, and Cleveland apparently was asleep.

Suddenly the two-way radio came awake with a frantic plea for help. Six officers had flushed a covey of 12 professional safecrackers and were finding them too hot to handle. The dispatcher hit the microphone button with a heavy hand. He pulled patrolmen out of all-night restaurants, off doorchecks, down dark alleys, out of taverns where they were looking for liquor law violators, from points all over the city, whether they were in their cruisers or not.

Within five minutes the neighborhood was saturated with 30 policemen. All 12 safecrackers were captured.

The gang consisted entirely of experienced criminals who would break into a place of business, take out the safe and be gone in a matter of seconds. The safes were stored in a warehouse and at intervals the gang would meet to break them open and split the proceeds.

After a year of investigation, the burglary detail set up a stakeout in the neighborhood of the warehouse. Detectives with a Motorola "Handie-Talkie" portable radiophone lay on the floor of a car, peeking out through small holes. Other detectives stayed within range of the portable radios, ready to relay any messages.

When two trucks pulled into the warehouse late one night, the watching detectives summoned their colleagues. Police drove into the driveway behind the trucks, only to see the 12 men burst through the warehouse doorway and scatter among surrounding buildings. As soon as the officers saw how badly they were outnumbered, they sent the radio message that startled the dispatcher out of his boredom.

At 1 a.m. a large proportion of police in any city are likely to be out of their cruisers, checking doors or drunks or even getting a sandwich and coffee. The Cleveland radio system incorporates Motorola Quik-Call, a selective signaling system through which the dispatcher individually controls the signal lights on top of the cruisers. Whenever Cleveland patrolmen have to leave their patrol car, they park it where it will be visible to them. If the radio-controlled light is turned on while they are away, they return immediately and call the dispatcher for instructions.

Cleveland police often leave patrol cars to make their rounds on foot. If headquarters has a message for them, the dispatcher pushes a button which turns on a light on top of the auto, recalling the officers to the car.

MEN LEAVE CARS

This "recall by radio" was conceived by Thomas E. Story, Cleveland police superintendent of communications, in 1946. He expected the system to be effective, but four years of experience have since indicated that he underestimated its potential.

Quik-Call has in effect returned the oft-lamented beat man to the streets of Cleveland. The new beat man is more effective, because he has a high degree of mobility. He is integrated into an intricate three-way communications system.

Beat men ride in patrol cruisers in most other cities, but in Cleveland they are not car-bound. They can step out of the car, walk around warehouses, serve warrants. They help at school crossings at noon, and conduct foot investigations whenever conditions justify the procedure.

One phenomenon has been observed repeatedly since the "alert lights" were installed four years ago. Because of the recall feature, the Cleveland police tend to con-

centrate at a point in two waves. The first wave consists of the officers who were in their cars when the initial call was made. The recalled officers form the second wave. Apparently the criminals expect only the first wave, because quite often they elude the first wave, only to be picked up by the second.

The present state of the radio system is the culmination of long-standing determination on the part of Cleveland police to utilize fully any device that might be turned to their advantage. They installed their first radio equipment, a one-way amplitude modulated system, in 1928 and have been operating continuously ever since, longer than any other police department in the nation. As early as 1939 they switched over to two-way FM, and in 1949 adopted their present three-way county-wide system with recall facilities.

Heart of the three-way system is the carrier-operated relay so connected that every radio message received at headquarters is retransmitted by the base station transmitter. Consequently, even though it is a two-frequency system, every cruiser hears both sides of every exchange of information, and cruiser-to-cruiser communication is used whenever necessary. There are many advantages to this arrangement.

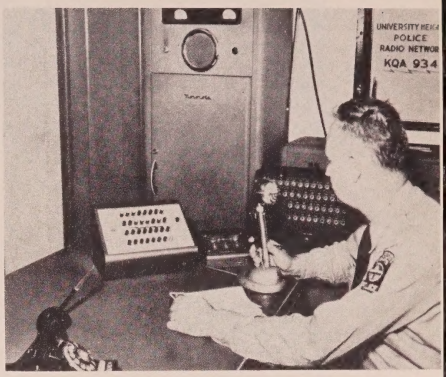
Cleveland police also use Quik-Call to unite 67 police and fire departments into one vast public safety organization covering all of Cuyahoga County and parts of the adjacent counties. The Cleveland dispatcher has a pushbutton system on his desk through which he can select and operate any police base station in the area as a relay station. Through these stations he can reach any of some 500 police and fire vehicles. All 500 can respond to him or talk through his equipment to any of the others. This unique example of civic cooperation is making Cleveland and its environs among the safest places in the country to live.

One June day in 1953, an outlying section of the city was devastated by a tornado. Ninety percent of the telephone equipment in the hard-hit area was knocked out. The dispatcher mustered both suburban and Cleveland units to eliminate all threats of looting, to isolate the areas made dangerous by live wires and structural damage, and to transport the injured. Cruisers were stationed outside near-by hospitals to keep the radio room informed of available bed space and emergency rooms.

CRIME RATE DOWN

The determination to utilize communications equipment to the fullest has contributed substantially to the excellent police record in Cleveland. In the first six months of 1953, there were fewer murders, assaults, larcenies, burglaries and auto thefts than in the corresponding period of 1952.

It would be unfair for radio to take all credit for this splendid record. Such a striking reversal of the national crime tendency requires above all that a city have good policemen operating under intelligent direction. However, some indication of the effectiveness of the radio system is illustrated in this incident:

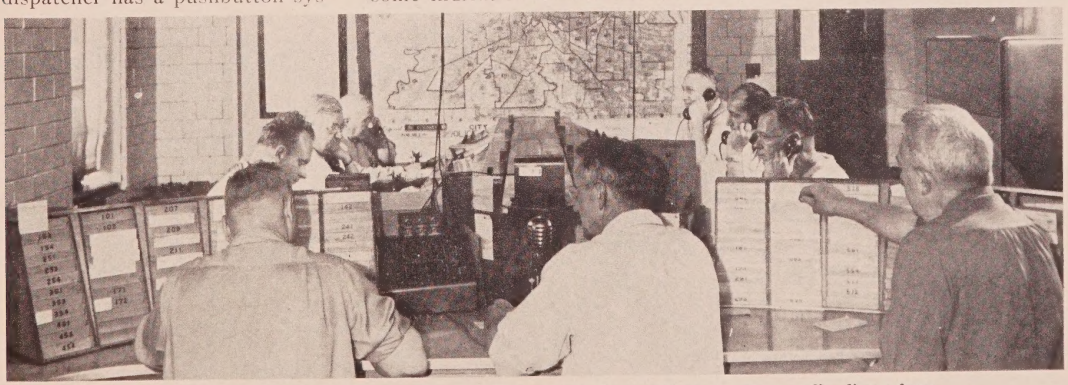


The police in suburban University Heights also use Quik-Call to alert officers who are away from the loudspeaker when their car is called.

Back in 1948, when Motorola went to Tom Story with the equipment capable of performing the recall job, he decided to try it out in the two highest crime rate districts before ordering a city-wide system. It was put in cruisers patrolling the Third and Fifth Districts.

Apparently there was an immediate reaction to the ability of the policemen to get out of their cars and nose around, because the crime rate in the two districts very shortly went into a sharp decline. At the same time the crime rate in normally quiet Fourth District, sandwiched in between the two recall districts, broke all records.

As almost any baseball announcer is likely to say: "How about that'."



Six men take incoming phone calls to police and feed complaints to three radio dispatchers.

PROGRESSIVE PLUMBER.... ....Triples

There may be plumbers who arrive to fix the leak in the kitchen sink without their pipewrench, but Harlan Plumbing Company's journeymen are not numbered among them. This progressive Phoenix, Arizona plumbing company tripled its service business in two short years through a combination of sound business judgment and solid customer satisfaction.

Two years ago Harlan was operating two repair trucks with most of their activities concentrated in new construction. At the time, Les, Archie and their father, J. W. Harlan, got together and did some hard thinking about the future. They looked at their market and decided home building was bound to decrease and the best way to hold their own sales volume was to build up their repair work.

Then they did something about it! Today Harlan has achieved an enviable balance between repair

Harlan's attractive new building with UHF antenna tower on roof is shown at left. Below is line-up of six radio equipped service trucks.

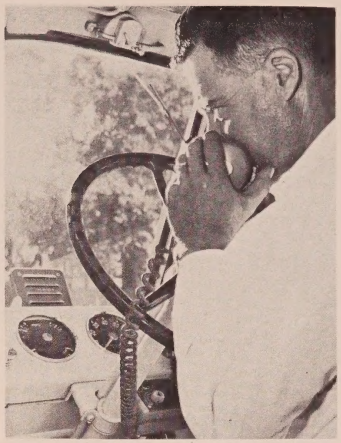
Service Business in Two Years

and contract work. They can afford to by-pass the new work being done at desperation prices.

From two to six repair trucks in two years is a real accomplishment. Clean white uniforms, polished trucks, fair prices, courtesy on the job—all these things helped, but Les Harlan believes much of the credit goes to their two-way radio system. Radio Controlled trucks give customers fast, efficient service that competition finds hard to match.

Does radio pay in the plumbing business? The best answer to that is the experience of Harlan. The company's outside auditor has facts and figures which prove four radio controlled service trucks do the work of five regular trucks. That means 20 percent more return on the cost of every truck and journeyman. Every dollar invested in men and equipment is working full time. Best of all, radio is a big part of the answer to the industry's toughest problem—making repair work profitable. With radio, ten stops per day per truck is the average at Harlan.

Seeing is believing and a day spent at Harlan will prove in deeds what the financial reports show in figures—that radio pays a profit.



Journeymen often call headquarters for advice when they run into trouble.

Symbol of progressiveness is Harlan's Cessna plane which Les Harlan uses to commute between Phoenix and Yuma branch.

At the right, Dispatcher Bud White checks the service log before radioing instructions to trucks.

The modern, attractive store front with the large sign attracts attention from passers-by.

Courtesy "The Mission Pilot"

TWO-WAY BUILDS FOR TH

modern equipment and skilled technicians assure customers of continuing good service

Above: a full stock of accessories and spare parts goes far toward insuring customers of continuous communications.

Below: the 128-foot tower lifts Two-Way Communications' antennas high above trees and power lines.

There are two ways to run a radio service business, but Two-Way only does it one way.

Two-Way Communications Service, Inc., shuns the "stick 'em today, for tomorrow we may be out of business" approach in favor of an "anything for our customers" attitude.

It pays off in profits.

This fast-growing Motorola service station in Traverse City, Mich., could serve as a pattern for anyone who thinks radio communication is here to stay.

For many years Motorola has been carefully building a National Service Organization to back up its equipment. At the customer's option, Motorola will contract to install and maintain the communications system. The work is performed by carefully selected technicians—all independent businessmen—under subcontract with Motorola.

These service stations operate under Motorola's rigid technical specifications and can draw on the cumulative engineering skill and experience of the company's quarter century in the radio communications field. Today there are more than 650 such authorized service stations throughout the United States, Alaska and Hawaii.

Two-Way Communications Service is a typical service station. Not so many years ago it was a sideline business for Jay V. Ealy, who had begun earning his way by installing early Motorola auto

THE FUTURE

Test equipment valued at $20,000 helps Two-Way's technicians keep customers' radios in top condition.

radio receivers while he was still in high school.

As his two-way radio installation business grew, Ealy started construction of a fine, new shop and office building in 1952, and at the same time he incorporated the business with himself as president and one of his veteran service men, Albert Maxbauer, as vice president.

Two-Way's service bench is the envy of northern Michigan. On hand are more than $20,000 worth of test instruments, within reach of the six skilled technicians. The bench was designed for maximum comfort and plenty of leg room for employees.

Besides having a well-equipped service and construction shop, Two-Way maintains a stockroom containing almost any conceivable part which might be needed. George Scheck, stock manager, keeps a running inventory to assure against shortages.

William E. Dunn heads the special construction section. In the fabrication department are a variety of power tools, lathes, metal bending, shearing and welding equipment used to construct special or custom units.

In addition to the stock of replacement parts, Two-Way keeps on hand several spare mobile transmitter-receiver units and "Handie-Talkie" portable radiophones ready for immediate use on frequencies most common in the area. These are loaned to customers whenever necessary at no cost. There also are low-power base stations in both low and high frequency bands.

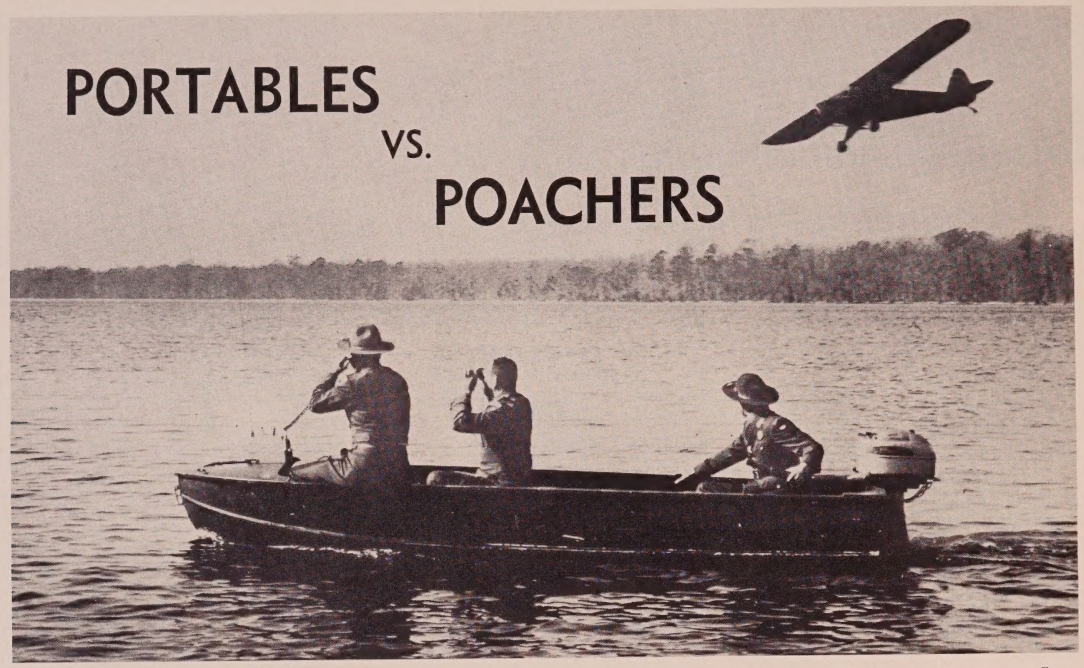
In conjunction with the emergency equipment, Two-Way keeps available several portable antenna systems which can be erected and readied for use in a matter of minutes.

It is this "plus" service to customers that has built Two-Way Communications from a small home shop into an organization now covering the northern half of Michigan. Among the accounts serviced on a scheduled basis are such varied customers as county highway maintenance, taxicabs, police, fire, highway trucking, light and power departments, construction, petroleum, pipelines, marine and aircraft.

On the basis of past performance and reliability, Two-Way Communications, Inc., is a key Motorola service station. As Jay V. Ealy phrases it, "We feel that Two-Way has but one item to sell, and that is service. Anything we can do to give our customers 100 per cent communications is worth the cost."

Jay V. Ealy, left, and Albert Maxbauer keep a fleet of two station wagons, two panels and one pickup truck available to speed service to their radio customers in northern Michigan.

PORTABLES VS. POACHERS



Alert officers, armed with portable and mobile two-way radios and strong field glasses, spell trouble for poachers in Idaho, North Carolina and elsewhere.

Idaho is putting radios in every game warden's car and will extend the wildlife network's usefulness with 15 portable "Handie-Talkie" radiophones. Eventually a string of powerful base stations will blanket the state from Boise through Pocatello and to the north.

Officers are mapping the lakes, selecting vantage points where the radio-connected agents can oversee widest areas.

The Idaho wildlife radios are bringing violators to justice, too. Recently agents brought in three poachers whose conviction resulted in levying of $900 in fines.

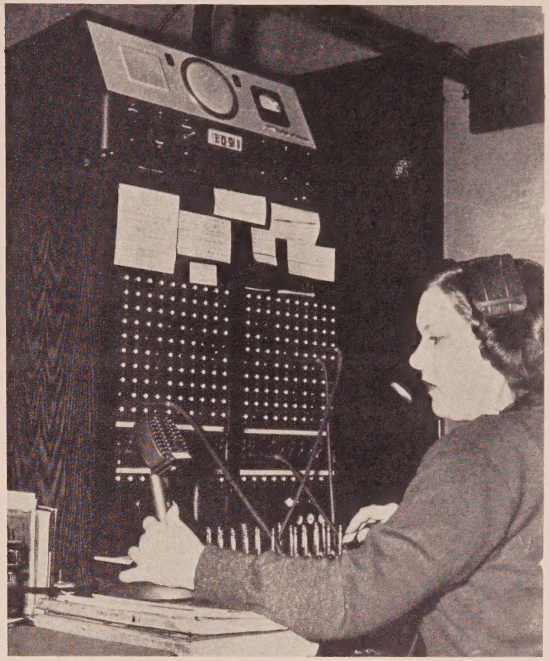
Idaho officials foresee other uses for the portable-mobile radios, especially search and rescue parties and civilian defense drills.

Above: Officers of the North Carolina Wildlife Resources Commission use Motorola "Handie-Talkie" portable radiophones to co-ordinate patrols in low-flying airplane and fast boat.

Below: Idaho Wildlife Agent Lee Hunt uses a back-harness to carry his Motorola "Handie-Talkie" portable radiophone when tracking down poachers.

RADIO BENEFITS SMALL RURAL TELEPHONE CO.

Even With Their Miles And Miles Of Lines And Cables, Telephone Companies Too Have Communications Problems.



When violent wind storms around Sloan, Iowa snap the lines of the Northwest Iowa Telephone Company, they don't stay snapped long. Since this small independent telephone exchange installed two-way radio in its service trucks, subscribers have suffered little from the inconvenience of an outage.

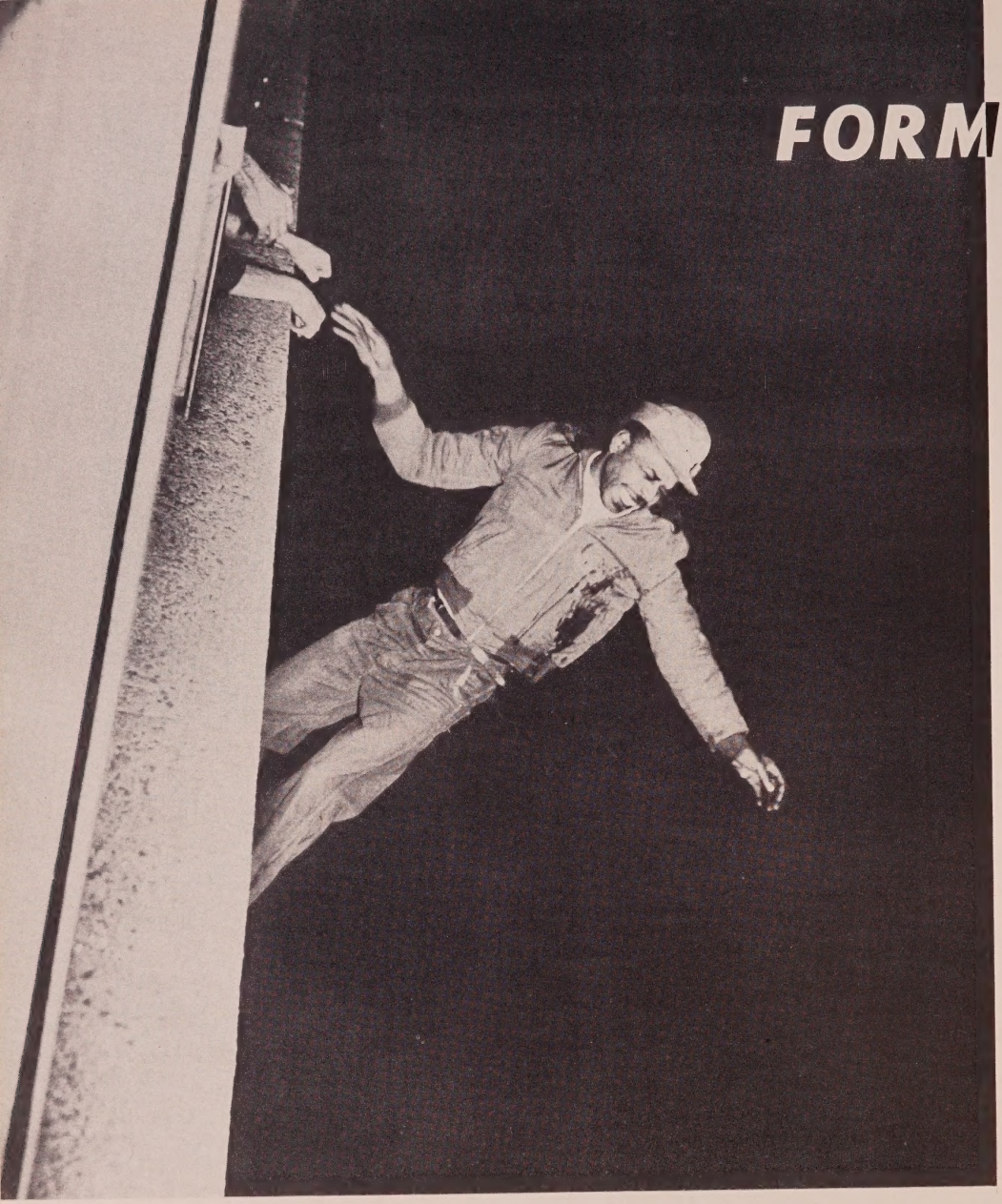
When the Federal Communications Commission's rules were recently amended to permit telephone companies to operate radio systems for emergency communications service, Art Long, owner and manager of Northwest, began planning his system. Within a couple months he was on the air with one base station and four mobile units, one in his car and three in service trucks. The system is relatively small insofar as the number of radio units are concerned, but it is extremely effective.

Gale Redmond, shown above in his Northwest service truck, is directed to the home of a subscriber by Operator Gladys Stanley at the switchboard.

The new radio system's primary job is to speed repairs and thereby improve customer service. With only a limited number of servicemen it is important to use their talents wisely. Without ever returning to the central office, the servicemen can go from job to job in a minimum amount of time.

Before the radio system went into operation, the repairmen phoned headquarters periodically for instruction during the day. This arrangement worked out as might be expected. Without fail, the calls came in when everything was running smoothly, but emergencies sat unattended for hours while the repairmen were busy elsewhere. With radio, the mountain can now go to Mohammed.

FORMULA



"HANDS OF LIFE, FACE OF DEATH"
By Bob Wendlinger Of The New York Daily Mirror

Top award winner in both Editor & Publisher and Hearst Photography contests in 1953.

FOR PICTURE HEADLINES

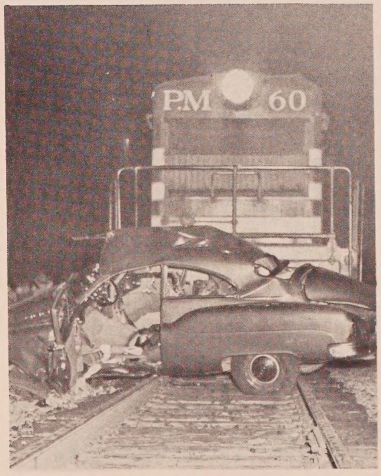
"If I had missed that picture, I'd have gone up there and jumped, too!"

These were the words of Photographer Bob Wendlinger of the New York Daily Mirror after shooting his prize-winning picture on the opposite page. Fortunately he didn't miss. Neither did his Mirror cohort Barney Coons who came up with the award winning shot at the right.

And one of the reasons they didn't miss was because they had two-way radios in their cars. These two pictures, like others appearing on the front pages of newspapers across the country and the two Chicago Tribune photos below, were made possible because editors were able to reach out through two-way radio and make fast, on-the-spot assignments.

"A GRIP ON LIFE"
By Barney Coons Of The New York Daily Mirror

Judged best spot news picture of the year by Editor & Publisher, University of Missouri School of Journalism, Hearst National Photographic Competition and Kent State University.



"Disputed Right-of-Way"

Photographer William Vendetta of the Chicago Tribune made this dramatic shot minutes after an auto and freight train crashed on Chicago's south side.

"Not Atomic"

John Austad, also a Chicago Tribune photographer, made this unusual shot of a chemical plant blast after getting his lead via radio.

RADIO . . .

Driver Wilbert Hastings answers radio call to find young cocker lying unconscious in the street.

Two-way radio, which is doing so many jobs so well these days, now is rushing aid to man's four-footed friends.

The Michigan Humane Society has equipped its four animal ambulances with Motorola 460-mc. radio as a means of providing faster first aid to pets in Detroit.

A Motorola transmitter on top of the Masonic Temple covers the entire city. When a call is received at Humane Society headquarters, orders are radioed to the closest animal ambulance and the driver is directed to one of the 39 neighborhood veterinarians who co-operate in the society's aid service.

The animals haven't said so, but they probably are as pleased with the new Motorola radio dispatching system as are officials of the humane society. It's a life-saver.

Above: Colored thumbtacks on a map of Detroit tell Ambulance Dispatcher Frank Hedge where to send Hastings with the injured dog. Last year the ambulances covered 70,000 miles and answered some 4,000 emergency calls. Most animals were victims of traffic mishaps.

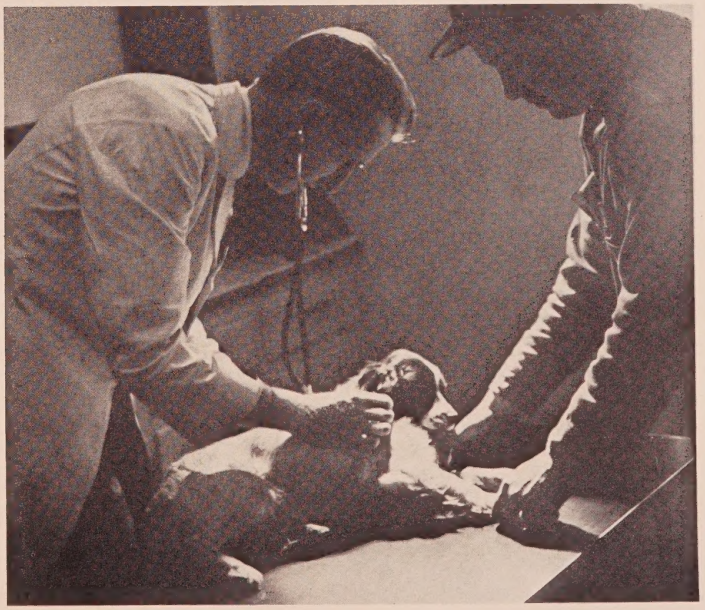
Right: After making the pickup, driver uses the two-way radio in his ambulance to give description of the injured dog and start identification procedure. Humane Society places great emphasis on returning lost and injured pets to their owners promptly.

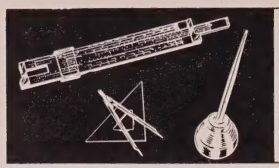
Chevrolet Photos

dog's best friend

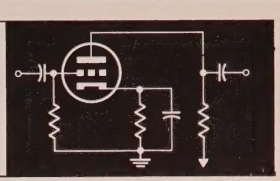
Above: Pet's ownership is no longer in doubt. The boy had discovered cocker missing after school and telephoned the Humane Society shelter, where he was told pooch awaited reunion.

Right: Dr. Stephen R. Kelly examines the dog for fractures, listens to its heart and administers sedation before trip to Humane Society shelter. Examination revealed no evidence of critical injuries.





Technical Notes Section



INTEGRATED SYSTEMS

THE TERM "INTEGRATED SYSTEMS" IS OFTEN USED TO DESCRIBE COMPLEX COMMUNICATIONS NETWORKS, ESPECIALLY ONE WHICH INCLUDES SEVERAL COMMUNICATIONS MEDIA.

A manufacturer of quality communications equipment will follow the accepted industry standards such as AIEE, IRE and RETMA as a basis for design of the equipment. However, even in quality equipment there is a difference in performance between the various makes as a result of differences in the manufacturer's engineering skills, manufacturing skills and desires to provide optimum communications service rather than merely complying with accepted equipment standards. There is further difference in the performance of the equipment in an actual system.

SYSTEMS

A single mobile radio unit, one microwave relay station or a lone power line carrier terminal is of little value in itself. To perform its function, it must communicate with other units. To communicate with other units, it must employ a medium of transmission between the two locations. Thus, a communications unit must be designed, not complete in itself, but rather to function efficiently with other units and auxiliary items. It is further necessary to include the characteristics of the transmission medium into the design of the unit. "Systems design" is necessary to insure that the individual communications unit fulfills its task of dependable communications as a part of the overall communications system.

SYSTEM TYPES

One of the simpler types of communications systems is the locally controlled desk-top VHF base station working with a single mobile unit such as is used by a small village police department or a veterinarian to cover a few square miles. An example of the more complex systems is the type employed by an electric utility which includes VHF radio, microwave, power line carrier and wire lines to convey voice, frequency shift VF carrier, supervisory control and other intelligence from place to place, often covering several states. For all systems between these two extremes, two types of system design are required, that of compatibility of performance between the various elements of the system as can be determined from laboratory tests and that of actual performance of the system in operation.

DESIGN

System design takes in many facets. For example, in the case of the simple VHF radio system, the following items, among others, are considered:

1. Is the receiver audio response characteristic properly matched to the transmitter audio characteristics to provide maximum intelligibility for the received signal?
2. Is the receiver modulation acceptance correlated with the transmitter modulation bandwidth with adequate allowance for expected frequency variations and, conversely, is the frequency tolerance of the system correlated to transmitter and receiver bandwidth characteristics?
3. Is the antenna properly matched to the transmitter and receiver for optimum energy transfer?
4. Are the antenna radiation patterns, antenna tower heights, and antenna geographical locations properly selected to provide adequate signal strength in the entire area to be covered?
5. Are frequencies, locations, powers, and performance characteristics chosen to minimize the possibility of interference to and from other radio systems?
6. Is the receiver sensitivity and signal-to-noise ratio adequate to provide satisfactory communications on weak signals, in areas of high ambient noise levels, and under unfavorable conditions?
7. Is there an adequate safety factor of performance included in the system design to provide dependable communications under the worst possible conditions?

8. Is the system and the equipment in the system adaptable to changing channelization plans, changing primary power sources in vehicles and other possible variables without excessive modification costs?

9. Have the effects of wind and weather on the antenna, shock and vibrations on mobile units and power line voltage variations on base stations and other operating problems been taken into account?

10. Have all technical factors been balanced against costs to arrive at optimum communications at minimum cost?

These factors present a sample of some of the considerations involved in selecting the proper equipment for a simple communications system. It is obvious that the more complex a system becomes, the greater the number of factors there are to be considered.

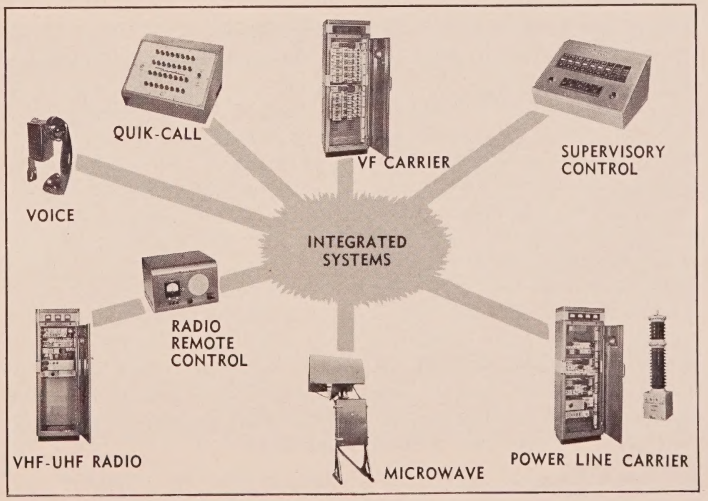
ENGINEERING

Long recognizing the importance of systems engineering, Motorola has, at the factory, a systems consulting engineering service and a systems engineering department devoted to design and development of equipment and combinations of equipment to fulfill a specific user's requirement. This engineering group backs up the Motorola Communications Engineering force throughout the country, providing technical assistance wherever and whenever requested by the field engineering force. In addition, each individual engineering section has a coordinating function to insure that each component of the system fits into one master plan. Thus, through attention to both equipment design and systems design, the Motorola customer is assured of both quality equipment and quality performance of that equipment in its end use.

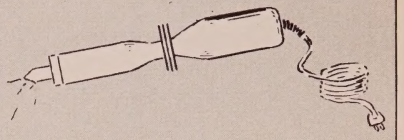
MULTIPLE SYSTEMS

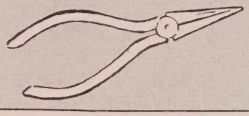
The attention given to detail in designing a simple VHF radio system is multiplied when the system includes additional types of equipment and auxiliary equipment. Integrating various control and communication functions into such a system involves correlating all equipment into a single functional plan. QUIK-CALL selective signaling in the VHF radio system must not only be integrated with the radio equipment but with microwave, power line carrier, wire line systems or other media if they form part of the circuit. VHF base stations must be adaptable for control via the various means of transmission—microwave, carrier or wire line. Frequency shift VF carrier for teletypewriters, telegraph, telemeters and load control must function equally well with VHF radio, microwave, carrier and wire line transmission media. Supervisory control equipment also must perform uniformly over the various media. Power line carrier (with aperiodic coupling units to couple carrier power to high voltage transmission lines) must be capable not only of voice communications from point-to-point but also capable of handling other control and communications intelligence. Microwave termination facilities must be adaptable to extremely wide variations in the amount and type of intelligence transmitted.

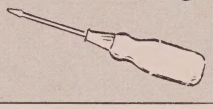
Through concentration of engineering efforts in the electronic communications field and rise to prominence in the field, Motorola has achieved the position of being capable of supplying full communications systems, integrated systems made up of components designed and engineered to work together, plus thorough system performance planning, to provide the best in communications. To keep the best in communications, you get follow-up engineering and maintenance services and, if desired, a Motorola maintenance contract—sale responsibility with one manufacturer for equipment and maintenance. True integration of systems design, systems performance, system maintenance and system expansion.



SERVICE HINTS and SHOP NOTES







AUXILIARY VOLUME

The latest versions of Motorola receivers in the 25-54 mc. and 144-174 mc. Uni-Channel Series and 450-470 mc. Sensicon series include a new type volume control circuit which employs variation of B+ voltage to the receiver second limiter and D.C. amplifier stages. Normally the speaker level is varied with a control head or control panel potentiometer (500,000 ohms). In some cases, however, the receiver output level was preset by inserting an 82,000 ohm fixed resistor from B+ to the controlled stages and the speaker level is controlled by a speaker pad (20 ohms). The speaker pad is used when the mobile unit employs QUIK-CALL or is intended to be interchangeable with earlier models which do not have the receiver DC volume control circuit.

If required, it is possible to realize greater audio output capabilities of the receiver by adding the K-9354 Volume Control Kit to the receiver chassis and removing the 82,000 ohm resistor. This kit mounts over the audio output transformer and allows variation of the preset receiver output level at the chassis. The control panel or control head volume control is then set by the operator for the desired speaker level.

PARTS & SERVICE

The Parts and Service Department of the Motorola Communications and Electronics Division will soon be located in new quarters. By August 1, 1954, the complete department will be transferred from the familiar address at 1327 W. Washington Blvd. in Chicago to spacious new accommodations at 1414 N. Cicero Ave., also in Chicago. Improved facilities are expected to increase efficiency and achieve the goal of shipping all orders within 24 hours of receipt. Motorola users as well as Motorola Service Stations will receive the full benefits of this faster service.

Remember, after August 1, 1954, it's:

Motorola
Communications & Electronics Inc.
Parts & Service Dept.
1414 N. Cicero Ave.
Chicago 51, Ill.
Phone: EStebrook 9-0122

"B" BATTERY LIFE

For dependable service in "Handie-Talkie" portable units, the 67½-volt "B" battery should not drop below 50 volts in one minute with a 2000-ohm, 20-watt wirewound resistor across its terminals.

MOBILE SPEAKERS

In various applications, mobile speakers may be subjected to everything from the damage of spilled coffee to excessive exposure to cement dust. To provide added protection in Uni-Channel under-dash mounted and AC Utility models, a polyethylene film has been added behind the speaker grill and in front of the speaker. This film (Part No. 35B834775) can be added to earlier models if desired. This same film can be added to firewall speakers in the P-8263 Series between the speaker and the grill. For the rear grill of the P-8263 Series Speakers, a saran cloth (Part No. 35A483192) can be installed with rubber cement if desired.

CONVERTER

The TA142 12-to-6 Volt Vibrator Converter Unit was originally designed to convert early 6 volt mobile radio units in the 20 to 30 watt transmitter RF output category for operation in 12 volt vehicles. It may also be used with 10-12 watt mobile units by making a few minor changes in the installation procedure.

For use with the lower powered mobile units such as the Motorola models in the FMTRU-41V and FMTR-41V series, the installation instructions given in the instruction manual for the

converter (68P831858-0) should be followed except for paragraphs 3.b. and 3.c. These two paragraphs should read:

b. Connection

(1) Cut the BLACK #8 power cable (connecting the mobile radio housing power plug to the "A" relay) at a point within "cable reach" of the TU179 Converter Unit. Attach a cable lug (supplied with the TK197 Accessory Kit) to each "cut" end of the cable.

(2) Connect the section of cable **from the mobile housing power plug** to the "R" **OUTPUT** terminal of the TU179 Converter Unit. Use one of the ¼" nuts and lockwashers supplied with the TK197 Accessory Kit.

(3) Jumper the "R" and "T" **INPUT** terminals of the converter unit with a short piece of #18 or larger wire.

(4) Connect the section of cable **from the "A" relay** to either the "R" or "T" **INPUT** terminal of the converter unit. Use the ¼" nuts and lockwashers supplied.

(5) Connect the ground terminal of the converter unit to the vehicle frame. Use the 3½' BRN/BLK/RED ground cable and one of the nuts and lockwashers supplied.

c. Fuses

Remove the 15 ampere fuse from the converter and replace it with either one of the other fuses (25 ampere) from the other converter fuse holders. No fuses are required in either of the two 25 ampere fuse holders for this application. The mobile unit power cable fuse and mobile unit internal fuses are not changed.

Be sure the 15 ohm "dropping" resistor is installed in series with the "A" relay (between relay terminal "B" and the white wire).

DUST COVER

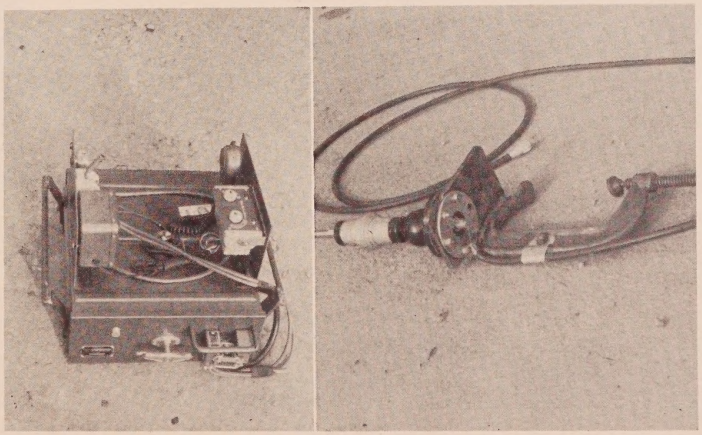
Dust is one common cause of relay malfunction. In applications and geographic locations where dust and other airborne particles can create difficulties, relay covers may be desirable. For 10-12 watt Uni-Channel mobile units (early FMTRU-41V and FMTR-41V Series) a transmit-receive relay dust cover kit is available. The SK-9424 Relay Dust Cover Kit consists of a relay cover, a mounting bracket, associated hardware and installation instructions. By drilling two small holes in the chassis, the transmit-receive relay can be moved from its under-chassis position and relocated atop the chassis under a dust cover. This kit, the SK-9424, is available from the Motorola Parts Department in Chicago and from the Dallas and San Mateo Parts Depots.

PORTABLE MOBILE

A Motorola user, Walt Kunz of Cincinnati, Ohio, has adapted a conventional mobile radio unit to be not only transferable from vehicle to vehicle but also to serve in any vehicle in which the power cables and antenna are not permanently installed. In this capacity, the mobile unit makes a radio equipped truck out of any of the vehicles and also doubles as a temporary base station, operating from a vehicle battery.

As shown in the illustrations, the antenna is mounted on a metal plate welded to a "C" clamp. This permits rapid simple antenna installation on the corner of the truck bed. The speaker, fuse block, "A" relay, control head and microphone are all mounted on metal panels fastened to the top of the mobile housing. Carrying handles are welded from pieces of steel bar and rod as shown and fastened to the side of the mobile housing.

The installation is thus complete in itself, is easily transported from place to place and requires only connection to a battery to be placed in operation.



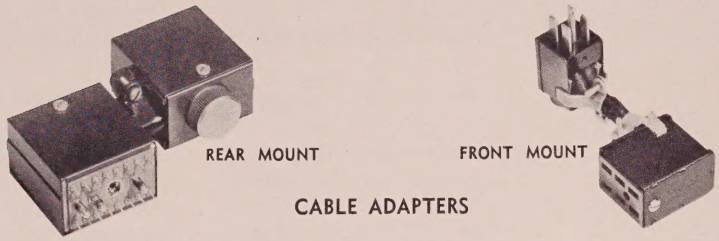
"Portable-mobile" radio developed by Walt Kunz, Cincinnati, Ohio.

NEW 6/12 VOLT MOBILE RADIO

UNIVERSALLY INTERCHANGEABLE

. . . . between 6 and 12 volt electrical systems *without modification*

. . . . with earlier 6 or 12 volt Motorola Models by using cable adapter



CABLE ADAPTERS

6/12 VOLT RADIO

The Universal UNI-CHANNEL 6/12 volt radio, developed by Motorola engineers, provides freedom from obsolescence and the advantages of standardization. The unit is completely interchangeable *without modification* between 6 and 12 volt vehicular systems. The power circuit design (a Motorola exclusive) is based on a unique series-parallel power supply and filament interconnection (patent applied for). The radio set is completely wired for 6 volt operation *and* 12 volt operation. The same radio set can be used in either a 6 volt or a 12 volt vehicle *without throwing switches, changing jumper connections, substituting power supplies or making any other modifications.* All necessary connections are completely provided by the appropriate external power cable installed as an integral part of the vehicle.

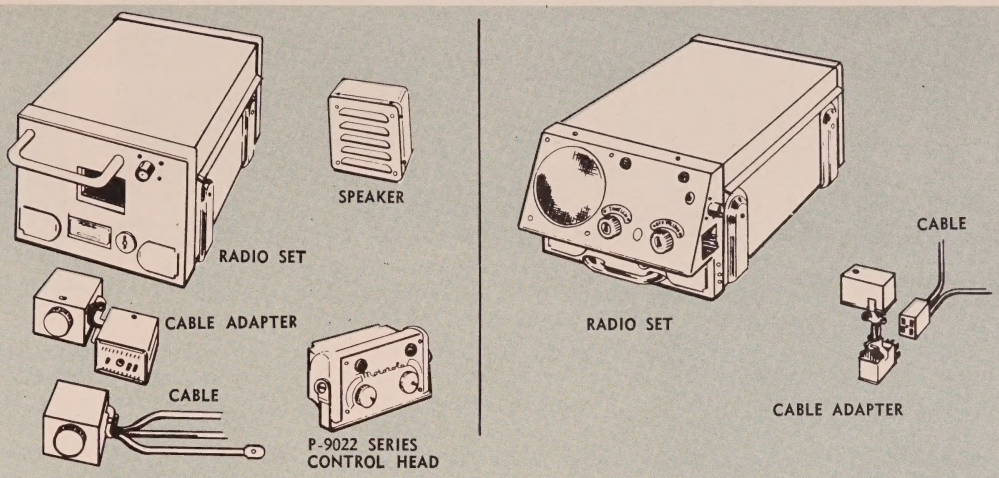
A 6 volt power cable is installed in every vehicle with a 6 volt electrical system; a 12 volt power cable is used in 12 volt vehicles (a 6 volt cable is readily convertible for 12 volt vehicular installation). The same radio set operates universally and interchangeably from either cable. Any spare mobile unit can be used in any vehicle in the fleet.

In the 25-54 mc. range, the T41G (trunk-mount) and D41G (under-dash-mount) Series Models are available with 25-30 watts RF output. In the 144-174 mc. range, the T43G (trunk-mount) and D43G (under-dash-mount) Series Models are available with 20-25 watts RF output; the T33G and D33G Series are companion 144-174 mc. 10 watt models.

ADAPTABILITY

Not only is the new 6/12 volt radio equipment interchangeable between 6 and 12 volt electrical systems *without modification,* it can also be easily adapted for interchangeability with earlier 6 or 12 volt Motorola equipment still in use. The new 6/12 volt models can be added to, intermixed with, and interchanged with FMTR-41V and FMTRU-41V Series Models by the use of "cable adapters". These cable adapters make it possible to use the new 6/12 volt radio sets in existing "41V" Series cable installations, preventing obsolescence of earlier equipment and eliminating the necessity of stocking several types of spare units. The cable adapters also allow the earlier 6 and 12 volt radio sets to operate with the new 6/12 volt cable installations. As new radio equipment is added to the system, the user can incorporate the most modern units and acquire even greater interchangeability than provided by the original equipment.

Motorola customers with the earlier "41V" (6 volt) and "41-12V" (12 volt) Series UNI-CHANNEL radio equipment can enjoy the advantages of universal cable installations while (1) replacing earlier 6 and 12 volt radio sets with the new 6/12 volt radio sets and/or (2) expanding their fleet with new 6/12 volt radio equipment. The cable adapters and control head jumpers permit 6/12 volt radio sets to operate in all vehicles (both 6 and 12 volt) in the fleet; the earlier 6 volt radio sets to operate in all 6 volt vehicles in the fleet; and the earlier 12 volt radio sets to operate in all 12 volt vehicles in the fleet. Interchangeability of all equipment is attained even during the transition period of incorporating 6/12 volt equipment in the system.



Cable adapters allow (1) new 6/12 volt radio sets to operate from earlier 6 or 12 volt cables and (2) earlier 6 or 12 volt radio sets to operate from new 6/12 volt cables.

ADVANTAGES

UNIVERSAL INTERCHANGEABILITY between 6 and 12 volt electrical systems *without modification;* and with earlier 6 and 12 volt radio equipment through minor adaptations.

OBSOLESCENCE-FREE 6/12 volt operation is applicable to mixed fleets and future vehicles.

EASY MAINTENANCE—stocking of duplicate spare units for vehicles with different voltages and cable installations is unnecessary.

UNEXCELLED EFFICIENCY of new 6/12 volt power supply circuitry requires less battery drain.

CABLE ADAPTER APPLICATION CHART

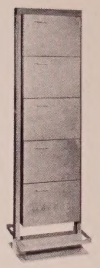
IF YOU HAVE RADIO SET	*REAR MOUNT		FRONT MOUNT	
	WITH CABLE KIT	USE ADAPTER	WITH CABLE KIT	USE ADAPTER
6/12 VOLT T41G, T33G, and T43G or D41G, D33G and D43G Series	TK161 or TK208 (6/12-6 VOLT)	NONE	TK190 (6/12-6 VOLT)	NONE
	TK162 or TK209 (6/12-12 VOLT)	NONE	TK191 (6/12-12 VOLT)	NONE
	K-9037 or K-9037-A ("41V"-6 VOLT)	TK211	K-9038 ("41V"-6 VOLT)	TK215
	K-9037-12V ("41-12V"-12 VOLT)	**TK213	K-9038-12V ("41-12V"-12 VOLT)	TK217
"41V" (6 VOLT) Series	K-9037 or K-9037-A ("41V"-6 VOLT)	NONE	K-9038 ("41V"-6 VOLT)	NONE
	TK161 or TK208 (6/12-6 VOLT)	NONE	TK190 (6/12-6 VOLT)	TK216
"41-12V" (12 VOLT) Series	K-9037-12V ("41-12V"-12 VOLT)	NONE	K-9038-12V ("41-12V"-12 VOLT)	NONE
	TK162 or TK209 (6/12-12 VOLT)	TK214	TK191 (6/12-12 VOLT)	TK218

*"41V" and "41-12V" Series Radio Sets operate only with P-9022 Series Control Head. 6/12 volt Radio Sets operate with either P-9022 Series Control Head or TU124, TU146, TU147 and TU203 Series Control Heads.

**A minor wiring modification is required for full interchangeability in this case.

KEY AND LAMP ASSEMBLY

Motorola SUPERVISORY CONTROL EQUIPMENT



TERMINAL STATION

"Building block" packaging provides an economically flexible system with compact, accessible, and attractive station equipment.

Motorola supervisory control equipment permits "push button" selective control of remotely located apparatus and supervision of the operation of that apparatus by colored indication lamps, providing centralization of control for the "big picture" of overall system operation with related improvements in efficiency of operation and protection of expensive equipment.

Sequential audio tone multiplexing combines maximum system security with ease of transmission over almost any medium or combination of media including: power line carrier, VHF radio, microwave relay, wire line, etc. Standardized components are assembled with a "building block" technique to permit custom design of a small or large system with adequate provision for future expansion.

KEY & LAMP ASSEMBLIES

The Motorola supervisory control system is a "select-before-operate" system; i.e., the operator first selects the remote apparatus to be controlled by pressing the key on an associated *key & lamp assembly* and then, (after the selection and status of the device are verified by a returned signal) performs the desired operation by pressing the appropriate *master operate key* which is common to all remote apparatus or devices.

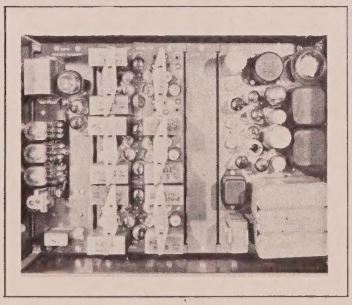
Each *key & lamp assembly* is associated with a specific apparatus or device and contains three lights (red, white, and green) and a selection key. The selection key is the momentary press type and is used to select a remote device for operation over the supervisory control system. The red and green lights indicate the position or status of the remote device such as "on-off", "open-closed", etc. The white light indicates that the remote apparatus has been selected and is ready for an operation to be performed. *Master operate keys* initiate operations such as "on-off", "open-close", etc. on remote devices selected for an operation by the *key & lamp assemblies*. The *master operate keys* are recessed to avoid accidental operation.

Key & lamp assemblies are used on a unit requirement basis, i.e., one (1) per controlled device, etc. Each *master operate key* is used with a group of *key & lamp assemblies* to perform a specific operation on a selected device.

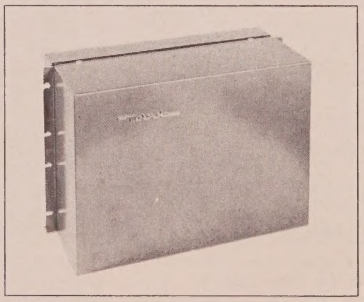
Key & lamp assemblies and *master operate keys* can be mounted on the door of a cubicle (as shown on the opposite page) or on a table-top console located in the area of the master station equipment.

PACKAGING

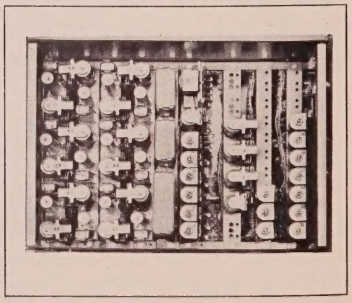
All Motorola supervisory control equipment (with exception of the *key & lamp assemblies* and *master operate keys)* is packaged in attractive metal cases which are identical in size and shape and are designed for standard 19-inch rack mounting. No specially punched cabinets or panels are required for their installation. These cases are finished with automotive-type baked-on dark grey enamel and are completely enclosed as a protection against dust and other



ELECTRONIC CASE



"BUILDING BLOCK" CASE



CODER-DECODER CASE

foreign particles which might be detrimental to the equipment. Front and back covers are easily snapped on and off without the inconvenience of loosening or removing lock-nuts and other types of holding devices. The cases can be mounted in open racks, cabinets, cubicles or panels to provide a system that occupies minimum floor space and allows free access to any part of the equipment quickly and easily.

TYPES OF CASES

Cases are defined by the type of equipment they contain. There are three basic types of cases which are common to both the master (or control) station and the remote (or controlled) station: (1) Electronic Case, (2) Coder-Decoder Case, and (3) Point Case.

The Electronic Case contains all of the electron tube circuits at a station including the Vibrasender tone oscillators, and the transmitting and receiving amplifiers. It is used at both master and remote stations to generate tone frequencies and regulate signal levels. The Coder-Decoder Case contains the Vibraspondders and relay equipment common to all points in the station, including the tone timing circuits. The Coder-Decoder Case constructs the outgoing tone codes (sequence and transmission timing of outgoing frequencies) and identifies the incoming tone codes, initiating operation of relays in the Point Case.

The Point Case is a "building block" component which contains relays associated with each individual function. Each Point Case has a capacity of 18 points of operation. A "point" is defined as a single control and/or supervision channel for remote operation or monitoring. All the necessary wiring for the full 18 points of supervision and control is included in all point cases. Relays, however, are included in the case only for the number and type of control and supervision functions to be provided. The amount of "add-to" equipment required for each subsequent additional point is determined by whether the point is for control only, supervision only, or control and supervision. "Add-a-point" kits are available which contain all the equipment necessary to add a *control and supervise point* or a *supervise only* point. This is an economy feature since only the equipment necessary for the specific type of point desired is supplied.

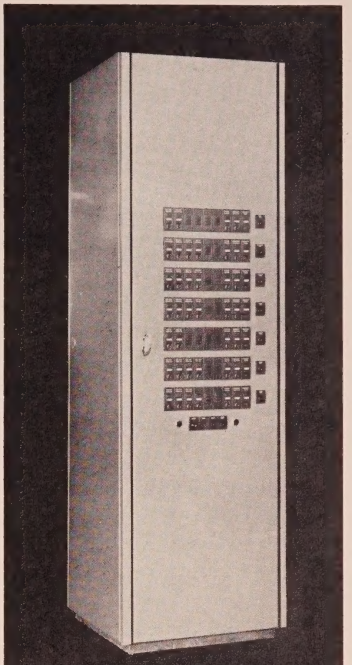
STATION ASSEMBLY

From one to five Point Cases, or a maximum of 90 control and supervision points (more than sufficient for most systems), can be used with one Electronic Case and one Coder-Decoder Case. Additional points can easily be added to a system by using an additional Electronic Case and Coder-Decoder Case with up to five more Point Cases for another possible 90 points, etc. A typical master station mounted in a cubicle (shown on this page) consists of the *key & lamp assemblies* and *master operate keys* on the front door and (from top to bottom) an Electronic Case, Coder-Decoder Case and four Point Cases. Motorola supervisory control equipment can also be mounted in cabinets, open racks, or panels.

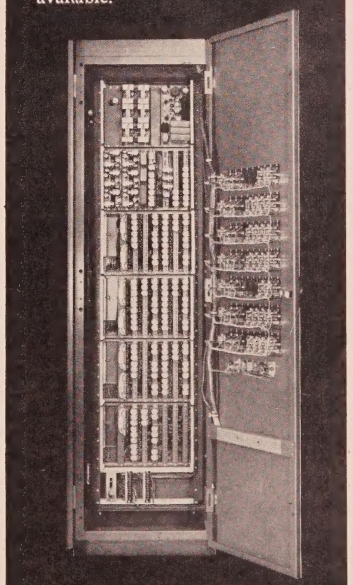
STANDARD SYSTEMS

One standard master station can control and supervise up to 90 points over any one of three portions of an audio channel (100-300 cps, 350-1100 cps, and 2700-3300 cps). These 90 points can be distributed among as many as 10 remote stations. Each remote station requires an Electronic Case, Coder-Decoder Case and from one to five Point Cases depending on the number of points at the remote station.

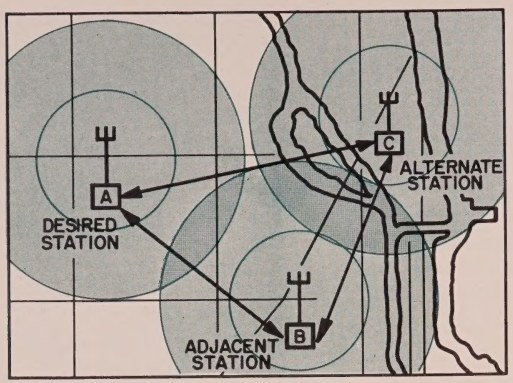
Technical Bulletin E-109, available from the Technical Information Center, provides a more detailed description of Motorola supervisory control equipment.



TYPICAL MASTER STATION MOUNTED IN CUBICLE as one compact unit. Full length front and rear doors provide easy access to equipment. Cabinets and open racks are also available.



(case covers removed)



INTERMODULATION

The concept of several signals mixing to produce other signals is not new. The case of intermodulation interference in VHF communications systems has become of serious import only in recent years.

To approach the subject of intermodulation of radio frequency signals, it is necessary to briefly review the mechanism called mixing. Combining two signals in a non-linear circuit (mixing) will produce, at the output, the two original signals, a sum signal and a difference signal plus harmonics of the original signals plus intermodulation products of the harmonics. The non-linear characteristics of the mixing circuit can produce additional harmonics of either signal and mix them with original signals to produce other sum and difference signals. The type of non-linearity determines, in part, the number and amplitude of the additional frequencies produced. Non-linearity in circuits also produces amplitude distortion in vacuum tube amplifiers, rectification in power supplies, and detection in radio receivers.

INTERMODULATION

In VHF and UHF communications systems, the term intermodulation generally infers the mixing of signals from two or more channels which combine to produce an interference signal on another channel. The simple and most common case is defined mathematically by the equation: $nf_a - f_b = f_i$ where n is the order of the harmonic of one of the signals, f_a and f_b are the signals causing interference and f_i is the intermodulation or interfering signal. As an example, if f_a is 152.06 mc., f_b is 152.12 mc. and n is 2, the intermodulation product is 152.00 mc. The strongest products occur when n is 2, when both signals are strong, and when both signals are close to the desired frequency. Receiver RF selectivity will greatly reduce signals far off the desired frequency. However, in the case of very strong signals, those signals far from the desired signal cannot be neglected.

Note that the example uses only two frequencies; combinations of a greater number of frequencies can also produce similar results. This, however, is rarer because all signals must be transmitted simultaneously.

EXTENT

The amplitude of the interfering signals and the interference they create to the reception of the desired signal is determined by a multitude of factors. Currently, only a few radio systems in large metropolitan areas have encountered an appreciable intermodulation problem and then only in areas of overlapping strong signal coverage from transmitters with closely spaced frequencies. Chances are that the systems outside metropolitan or frequency congested areas will have few intermodulation problems in the foreseeable future.

SOURCES

In general, there are two places that mixing of signals can take place to cause interference, in corroded metal joints near or on the receiving antenna and in the receiver itself.

Corroded or imperfect electrical contacts between members of the receiving antenna or tower (and other similar conditions) can cause strong signals to mix and produce intermodulation products. It is extremely difficult to locate such conditions, thus it is fortunate that the amount of interference from this source is small. Another possible source of intermodulation generation is through high RF energy levels from one transmitter being fed back into the output stage of a second transmitter, the two signals mixing in the output stage to produce the interfering signal. The second and more important source of intermodulation products is the receiver RF or mixer section. Although the receiver may be designed to produce uniform performance over an extremely wide range of input signals, it is virtually impossible to expect that the RF amplifier will be operating at the same point on its characteristic curves for a signal level of .1 microvolt and for a signal level of 100,000 microvolts or possibly 1 volt or more. Non-linear distortion, even though it may be infinitesimal, will be present even at the optimum operating point and will in-

crease away from the optimum operating point. This distortion is capable of producing intermodulation products to some degree, even though the distortion may be small.

RECEIVERS

Selectivity in the RF stages determines, in part, the amount of intermodulation either in the RF stages or the first mixer. By increasing the rejection presented to off-channel signals, the undesired signal strength available for intermodulation mixing is reduced. There are, however, limitations involved in this approach. Adding selectivity means adding tuned circuits ahead of the RF amplifiers which, in turn, means added circuit losses. A high degree of RF pre-selectivity results in relatively high losses and consequent low relative sensitivity of the receiver. To maintain the maximum operating range of a mobile radio system, maximum sensitivity must also be maintained. Hence, the number of tuned circuits in the RF stages is a compromise between maximum range and maximum intermodulation protection. Because the Permakay Filter rejects the undesired signals, the possibility of undesired signals reaching the final IF amplifiers to produce intermodulation is negligible.

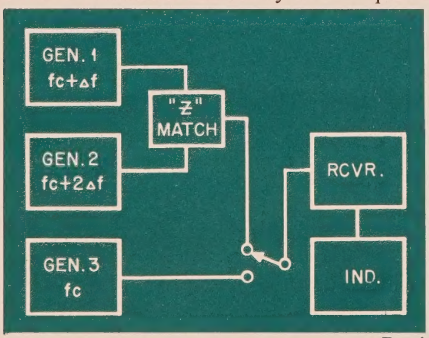
Another factor in receiver performance, related to intermodulation, is the RF gain. The RF stages must have high gain to achieve maximum sensitivity and maximum range. If, however, the signal level is above a few microvolts, there is no real need for maintaining the gain at the same high level. In fact, if the gain is maintained at a high level for high level signals, the undesired signals as well are given high amplification, and this results in poor intermodulation protection because the high gain is not required for the desired signal. Motorola receivers employ a delayed automatic gain control (AGC) circuit which permits full amplification of weak signals yet provides decreased gain for stronger signals to maintain a relatively constant desired signal level in the amplifier stages, while reducing the gain for undesired signals.

PROTECTION

For those cases where intermodulation interference has become noticeable in system operation, tuned cavities can be inserted between the receiver and the antenna for additional preselectivity. Available in several models to cover the conventional FM communications bands, the Motorola Precision Selector Cavities are manufactured in several versions. Though the use of different input and output coupling loops, the selectivity of the cavity can be chosen to meet the required system needs. Insertion loss of the various versions is from .5 to 3 db. depending upon the degree of RF selectivity required.

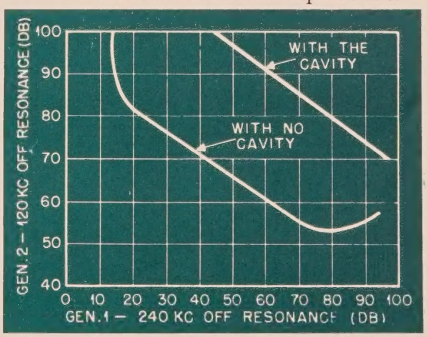
An effective method of countering intermodulation problems before they can occur is by judiciously selecting the system operating frequencies and antenna locations. As an example, one station alone producing a strong signal cannot produce intermodulation interference on another channel in itself. However, if a second station producing a strong signal in the same area is later erected, the combination of the two signals can produce intermodulation interference if the frequencies are such that a product will be produced on the desired channel. Location of a receiving antenna in any location where the signal from any other transmitter will exceed the receiver intermodulation threshold merits careful scrutiny. Pre-planning is always better than late corrective measures. The investigation of strong signal areas of other transmitters should include not only those on the same services and on adjacent frequencies but all transmitters in the area, including particularly high powered AM, FM and TV broadcast stations. Broadcast stations pose a problem in that they operate continuously while communications stations normally operate intermittently with less chance of simultaneous transmissions.

Proper frequency choice, plus proper geographical location, when combined with the use of the best radio equipment, can and will reduce the possibility of actual intermodulation problems.



A test set-up for checking receiver intermodulation response.

Precision Selector Cavities provide RF pre-selectivity for improved intermodulation protection.



Typical receiver intermodulation response characteristics showing effects of a pre-selector cavity.

TRANSMISSIONS . . . On Communications Topics

Radio Helps Save Village

Pushbuttons in Butler, Pa., recently helped save the neighboring village of Eau Claire from certain destruction.

The buttons—on Motorola Quik-Call selective signaling equipment—sounded fire sirens in five towns near Eau Claire, bringing firemen quickly when Eau Claire's lone funeral home caught fire late in March.

Funeral Director Ernest Bowser, who is also Eau Claire's fire chief, led his family to safety and then ran to the near-by fire station to sound the alarm and to radio Butler for help.

Central fire headquarters in Butler, which controls sirens in practically every Butler County town by radio control, routed out fire companies from Parker, Emlenton, St. Petersburg, North Washington and Grove City.

They were all at the scene within half an hour, Mr. Bowser said.

The funeral home was destroyed, but the mutual aid firemen were able to keep the blaze from spreading to a filling station next door. It is believed the entire village of Eau Claire would have been lost if the gasoline had been ignited.

"We lost the house—but saved the town," Bowser declared afterward.

It was the first major fire since the radio-actuated alarm system was installed early this year.

Truck Radio Rings Bell

Bell Aircraft Corporation has gone a long way toward solving intra-plant traffic problems at its 95-acre main plant at Niagara Falls, N. Y., by installing Motorola two-way radios in company trucks.

Use of the radios—licensed as a special industrial system on 43.10 mc—and merger of service routes is saving the company valuable time and providing rapid and efficient service, Bell officials report.

Besides equipping six trucks with the radio units, traffic officials assigned three truck operators to a "belt line" run on a plant-wide route embracing all departments which require pickup and delivery several times daily.

Use of radio and the "belt-line" run have speeded deliveries 50 per cent, officials estimate. Supervisors and foremen in distant sections of the plant can communicate with the dispatcher by radio at any time.

The radios and rescheduled routes are proving a boon to workers, too. Unequally distributed work loads and irregularity of calls have been minimized. The radios have a range of up to 15 miles.

REGIONAL DIRECTORY

For your convenience, there is listed below a complete directory of Regional Managers for Motorola Communications and Electronics, Inc. together with their offices and territories covered.

REGION 1
DONALD F. BRICKLEY
Idaho, Montana, Eastern Nevada, Oregon, Washington, Wyoming, Utah.
Office: 3833 N. E. Union Avenue
Portland, Oregon

REGION 2
EUGENE F. BROWN
Colorado, Iowa, Kansas, Minnesota, Nebraska, North Dakota, South Dakota.
Office: 817 Kilpatrick Bldg.
Omaha, Nebraska
Phone: WEBSTER 0017

REGION 3
HOMER L. MARRS
Illinois, Indiana, Missouri, Wisconsin.
Office: 1400 N. Cicero Ave.
Chicago 51, Illinois
Phone: ESTEBROOK 9-0122

REGION 4
GLENN MUNRO
Kentucky, Michigan, Ohio, Tennessee.
Office: 19142 James Couzens Hwy.
Detroit 35, Michigan
Phone: UNIVERSITY 3-6464

REGION 5
EDWARD L. FALLS, JR.
Arkansas, Louisiana, New Mexico, Oklahoma, Texas.
Office: 171 Parkhouse Street
Dallas 7, Texas
Phone: STERLING 4951

REGION 6
HORACE E. BOYLAN
Alabama, Florida, Georgia, Mississippi, South Carolina.
Office: Stallings Bldg., Rm. 601
1829 First Ave., North
Birmingham, Alabama
Phone: 4-4582

REGION 7
JOHN F. FUSSELL
Delaware, Maryland, North Carolina, Virginia, Washington, D.C., West Virginia.
Office: 2309 Calvert St., N.W.
Washington 8, D. C.
Phone: ADAMS 4-5620

REGION 8
P. R. KENDALL
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Office: 540 Main Street
Winchester, Mass.
Phone: 6-2482

REGION 9
LOWELL E. WHITE
New Jersey, New York, Pennsylvania.
Office: 102 Linwood Plaza
Fort Lee, New Jersey
Phone: 8-9100

REGION 11
FRANK W. WALKER
Arizona, California, Western Nevada.
Office: 6555 Sunset Blvd.
Hollywood 28, California
Phone: HOLLYWOOD 2-1378

WASHINGTON D. C. OFFICE
L. HARRISS ROBINSON
Federal Agencies

NATIONAL RAILROAD SALES
R. FLOYD McCALL
Office: 4501 Augusta Blvd.
Chicago 51, Illinois
Phone: SPAULDING 2-6500

MORRIS SPEAKS AT WEST COAST I. R. E. SESSION

The need for a more complete determination and understanding of VHF system requirements to avoid serious interference was stressed to West Coast IRE members recently when Lloyd Morris spoke to a Region 7 Technical Conference in Portland, Oregon.

Morris, chief engineer of the Motorola National Radio Systems Consulting Service, pointed up the need for industry-user-manufacturer committees on system design and allocation of frequencies. His slide talk centered on equipment design principles in light of harmonic, adjacent channel transmitter noise system desensitization and other interferences.

He recalled the relaxed approach of the 1940's, pointing out that the increasing dependence of industry upon rapid and easy communication places ever greater emphasis on efficient utilization of the available frequency spectrum.

Morris also touched on the economics of equipment design, pointing out that it may be advantageous to design for the average systems and then to meet the non-standard requirements with special equipment and accessory items.

Clinic Aids Service Men

Motorola Service Station operators and customer maintenance men from more than a dozen cities in California and Arizona attended a one-day Region 11 service meeting in Los Angeles recently.

National Service Manager John Tansey outlined the company's service policy for 1954 before a technical session led by Joe Jatis, Chicago. Covered were Sensicon receivers, 450 mc. transmitter and receiver alignment and loading, and operation of the Motorola frequency monitor.

Present, left to right, in the above picture were W. A. Kellogg, Region 11 service manager; Bob Kranhold, zone manager, Hollywood; Ed Williams, RCE, Hollywood; Tansey; Harold Van Childs, Region 1 service manager; Henry Pitts, San Mateo; Ed Kemper, Motorola Quality Control, Chicago; Ed Arms, Casa Grande, Ariz.; Frank Walker, Region 11 manager; Norm Quigley, Oceanside; George Bruns, Ventura.

Also W. J. Vannette, Los Angeles; Ted Kieling, Yuma, Ariz.; Charles Sheets, Los Angeles; LeRoy Wardell, Arroyo Grande; John Carl, Bakersfield; Charles Snow, Whittier; John Clark, III, zone manager, Hollywood; Charles Smith, Ventura; Bob Amsbury, Whittier; Ed Morin, Santa Barbara; and Jatis.

Shown seated are Jim Coin of El Centro and Gerry Peterson of San Luis Obispo, Cal.

Daniel E. Noble, vice president in charge of Motorola's Communications & Electronics Division, spoke on equipment reliability during a recent meeting of industry and government leaders at the 1954 Electronics Components Symposium in Washington, D. C. Theme of the meeting was new advancements in the electronics art. Left to right, speakers were M. Barry Carlton, Defense Department; R. S. H. Hylkema of Philips Industries, Eindhoven, Holland; Robert C. Sprague, RETMA board chairman; Brig. Gen. W. Preston Corderman, chief of Signal Corps Engineering and Technical Division; Noble; C. H. Elmendorf, Bell Telephone Laboratories; A. W. Rogers, Signal Corps Engineering Laboratories; and W. H. Martin, deputy assistant Secretary of Defense.

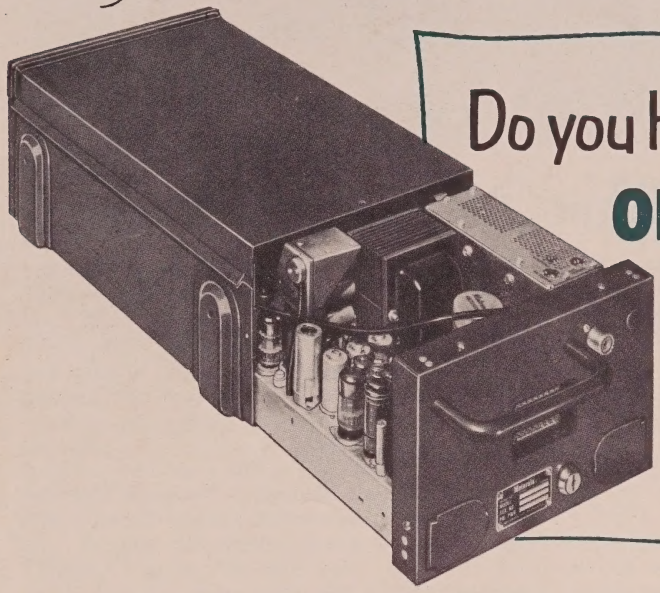
12 VOLT ELECTRICAL SYSTEM

These already have it!

NASH, OLDSMOBILE, BUICK, CHRYSLER, CADILLAC

How many will have it by 1955-1956?

FORD, PLYMOUTH, DODGE, CHEVROLET, PONTIAC, MERCURY, DE SOTO, HUDSON, STUDEBAKER



Do you have fleet radio OBSOLESCENCE INSURANCE?

Motorola had it *built-in* a year ago

A growing number of automobile manufacturers are changing from 6 to 12 volt electrical systems. Motorola 2-way radio now gives you built-in protection against expensive obsolescence should any part of your fleet be affected by this trend.

WHAT IT IS—It's truly universal 6/12V equipment—2-way radio that can be interchanged in mixed 6 and 12-volt fleets without modification of power supplies, jumpers, plugs, connectors, cables or switches. When re-installing in a 12-volt car, no cable replacement is required. It is so fool proof that you can safely make changeovers in the dark without worry of burning out tubes or damaging a power supply.

FEATURES—The *all-vibrator* power supply attains over 70% power conversion efficiency with a resultant power drain reduction of up to 40%—for more power per unit size per ampere drain than any other sets on the market. This, plus the superior performance of Motorola's famous Sensicon with guaranteed permanent selectivity and seven other exclusive features.

ACCEPTANCE—Again anticipating the trends, Motorola offers freedom from obsolescence, and superior performance at lower cost. You can easily see and hear the difference—greater signal strength, more audio power, longer battery and generator life, lower maintenance costs. You get all this in Motorola's truly universal 6/12-volt mobile units—available in the following classes:

- 25-54 mc., 25-30 and 50-60 watts R.F. output
- 144-174 mc., 10 and 25 watts R.F. output
- 450-470 mc., 18-20 watt R.F. output

Here is a partial list of Motorola 2-way Radio customers who had 6/12 volt interchangeable mobile units—a year ahead of the field

Michigan State Police
Ohio State Police
Shell Oil Co.
Community Public Service Co.
County of Orange, Calif.
El Paso National Gas Co.
Boston Edison Co.
Florida State Police
Iowa State Police
State of South Carolina

national Motorola RADIO COMMUNICATIONS service

Motorola Communications & Electronics, Inc.

A SUBSIDIARY OF MOTOROLA, INC.

4501 W. Augusta, Chicago 51, Ill. • Rogers Majestic Electronics, Ltd., Toronto, Canada